



**A STUDY OF POSSIBLE LOGISTICS PARADIGM CHANGES
TO BETTER MEET WARFIGHTER'S NEEDS**

GRADUATE RESEARCH PAPER

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GRADUATE RESEARCH PAPER

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Acknowledgments

During this year of study I have been enlightened on how the Air Force, as a vast organization, meets its logistics needs from transportation, to maintenance, to logistics planning to name a few. My eyes are now not solely focused on airlift and its virtues.

Many people have added to my expanding horizon and helped guide me in completing this research paper. Specifically, Col. Kent Mueller, AFSOC/LG, in his role as sponsor, provided an array of insight into the possible future of logistics. He also helped instill a sense of out-of-the-box thinking that will remain with me. At the Air Force Institute of Technology, Maj. Michael Rehg not only challenged me in two different courses, but also provided a truly professional academic's view to this paper. I also would like to thank the remaining faculty that came to the Air Mobility Warfare Center from AFIT to teach their thought-provoking courses. Speaking of the Warfare Center, they deserve a special commendation for assisting our class and providing their essential support. An honorable mention goes to the AMWC Librarian, Ms. Janice Missildine, who went out of her way to help us find that elusive research document that we were seemingly never able to find on our own. Lastly, and most important, to my wife, thank you for putting up with the year's separation and holding down the fort in South Carolina. I owe you my deepest gratitude and hope, in some way, to make it up to you. To my children, thank you for the time we were able to spend together – it helped make this year more tolerable. I look forward to going to the beach in Florida as often as you'd like.

Paul A. LaVigne

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Abstract

Currently, some Air Force logistics leaders have stated that even though the Air Logistics Centers (ALC) have been consolidated, they are still not as effective, as measured by time savings, cost savings, or system reliability as they can be. JV2020 even alludes to this need for change as a requirement for the future of our forces.

Therefore, this research proposes to identify and evaluate possible substitutes to some of the current logistics programs that affect aircraft availability including alternatives to depot maintenance and also, how to better move repair parts through the system to meet the warfighting vision of JV2020. This will be accomplished by looking at AFSOC's Depot Agile Repair Team (DART) program on the MH-53 helicopter, the Navy's H-60 helicopter, C-5 Lean Logistics concept, and the Army's Accelerated Logistics concept.

The study found a common thread among all these programs – a paradigm-breaking change in how to meet warfighters' needs and maintain cost effectiveness. The two helicopter programs both point to the need for keeping aircraft more operationally available and this is done by performing some depot-level tasks at the unit level. The DART concept has proven highly effective in increasing aircraft availability while also reducing costs. Also, by looking at the Lean Logistics and Accelerated Logistics concepts, these demonstrated another way to increase aircraft availability by moving replacement parts through the system more effectively.

A STUDY OF POSSIBLE LOGISTICS PARADIGM CHANGES TO BETTER MEET WARFIGHTER'S NEEDS

I. Introduction

*I abhor the sight of pen and paper and to put one t'other
requires as great a moral effort as for a cat to walk on hot coals.*

Lieutenant Robert E. Lee, 1834

Background

The Joint Chiefs of Staff recently developed Joint Vision 2020 (JV2020) as a template for the structure of our military's force of tomorrow. In it, they emphasize, "If our Armed Forces are to be faster, more lethal, and more precise in 2020 than they are today, we must continue to invest in and develop new military capabilities. This vision describes the ongoing transformation to those new capabilities (9:1)." Additionally, the new vision document concludes that:

This vision recognizes the importance of technology and technical innovation to the US military and its operations. At the same time, it emphasizes that technological innovation must be accompanied by intellectual innovation leading to changes in organization and doctrine. Only then can we reach the full potential of the joint force – decisive capabilities across the full range of military operations (9:36).

Here, the Joint Chiefs are not just referring to advancements in weaponry and delivery systems, but also improvements to other aspects – among them are logistics and specifically, its maintenance component.

Furthermore, to see how the AF can begin to achieve this, one must look at AF doctrine and the core competencies which "are not doctrine per se, but are enablers of our

doctrine. They begin to translate the central beliefs of doctrine into operational concepts (3:27).” These six Air Force core competencies are Rapid Global Mobility, Agile Combat Support, Information Superiority, Precision Engagement, Air and Space Superiority, and Global Attack. “Finally, it is important to remember that air mobility forces contribute directly to all the Air Force core competencies due to their speed and the global nature of the reach and perspective they provide (5:11).” In a world of unlimited funding, huge fleets of aircraft could easily support these competencies. Obviously, this is unrealistic. Therefore, aircraft systems that deliver this mobility contribution to the core competencies need to be at least as reliable as do the other systems to help make the whole system more effective.

General Michael E. Ryan, United States Air Force Chief of Staff, in a 27 September 2000, statement to the Senate Armed Services Committee, says that to support these core competencies, we must address certain deficiencies (26:3). Included in Gen. Ryan’s list of deficiencies is mission capable rates on aging aircraft. One request is for Congress to fund the acquisition of new aircraft to replace the increasing maintenance-intensive aircraft the Air Force currently possesses. Older aircraft are maintenance challenges, both in terms of getting replacement parts and repairing, especially when they have surpassed their initially intended service life. Most important to this research are the mission capable rates and some ideas on how to increase these.

The first of the following two figures from Gen. Ryan’s statement to the committee shows Air Force aggregate mission capable rates, TNMCS (time aircraft is not available due to no parts in supply) rates, NMCM (maintenance work is required to make the aircraft ready) rates, and finally, CANN (cannibalization of other aircraft) rates. All

four charts in this depict decreased reliability across the board. Even the small improvement in CANN rates still leaves the Air Force at a high rate. Also important, the second figure shows the decline of overall combat readiness of Air Force combat units since 1996 from 83% to 54%. This trend needs not only to stop, but also must improve in order to meet the vision of JV2020. Correspondingly, the Air Force must meet the warfighting Commander In Chief's (CINC) needs and possibly can by focusing on one of the deficiencies, maintenance effectiveness and its associated reliability rates.

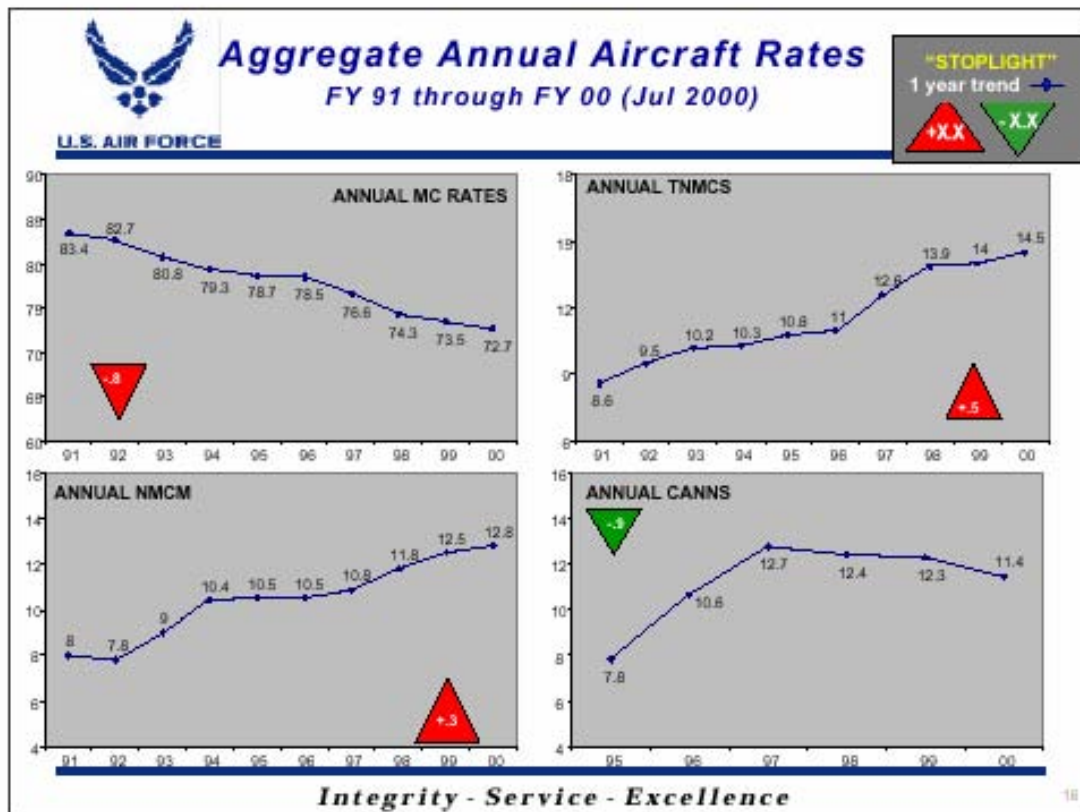


Figure 1. Aggregate Annual Aircraft Rates (25:n. pag.)

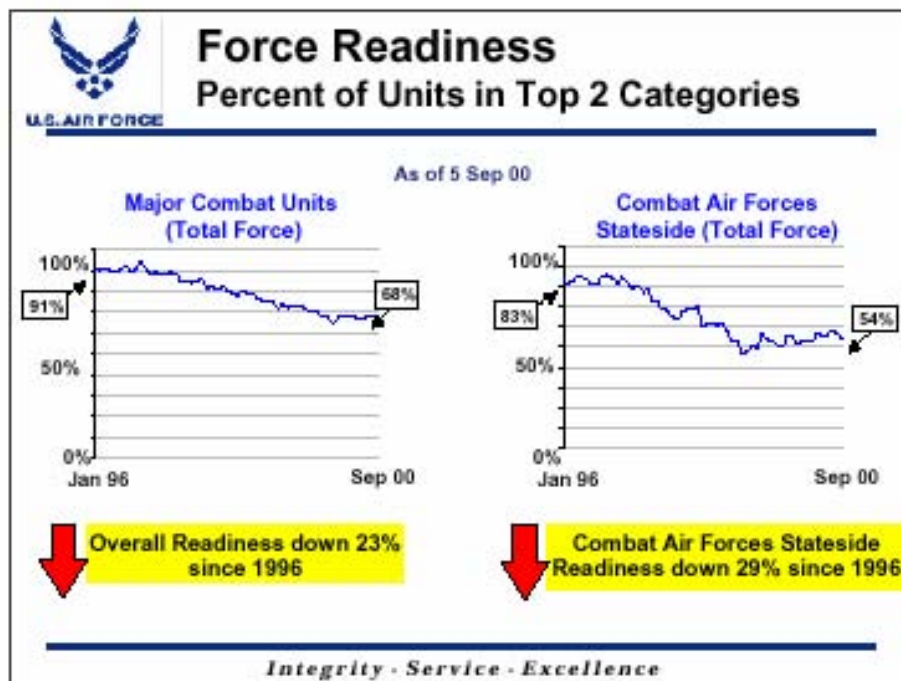


Figure 2. Force Readiness (25:n. pag.)

Currently, the United States Air Force (USAF) employs a depot maintenance program on its equipment that mainly use three logistics centers to accomplish most major support. These centers are the Ogden Air Logistics Center (ALC) at Hill Air Force Base (AFB), Utah, the Warner-Robins ALC at Robins AFB, Georgia, and the Oklahoma City ALC at Tinker AFB, Oklahoma. It is interesting to note that until recently, two other ALCs, Sacramento ALC at McClellan AFB, California, and San Antonio ALC at Kelly AFB, Texas, were operating. Consolidating these ALCs, as a result of winning the Cold War (thereby requiring fewer forces and aircraft) and the 1995 Base Realignment and Closure (BRAC), was done mainly to save taxpayer dollars.

In order to become the force that JV2020 envisions, the Air Force needs to consider how it currently operates and elicit ideas, no matter how non-standard, that

might bring about positive change. As military personnel, we “have undergone similar educations and professional initiations; in the process have absorbed the same technical literature and drawn many of the same lessons from it (20:177).” So, the paradigm (“beliefs, values, techniques, and so on... (20:175)”) has evolved following the evolution of the Air Force and is really based on historic knowledge, not forward-thinking at all. Adhering to a system (paradigm) that we’ve used for years is like putting on your favorite, old, comfortable clothes. You know how they feel, are satisfied with them, but after some time, they get worn and either need a patch or replacement. Inertia is very difficult to overcome in a large organization.

Stanley S. Gryskiewicz, Ph.D. in organizational psychology, in his book *Positive Turbulence*, assessed companies and analyzed how change affected them. Among his findings, he noted that “when a company avoids the trap of success and continuously searches for new ideas and new information, it is constantly renewing itself in accordance with the future world in which it must successfully operate (16:19).” Along with this, he finds that

diversity, varied viewpoints, different styles, dissenting opinions: all of these variances are necessary if a company is to renew itself and move ahead. The survival of a company does not depend so much on the degree to which the employees see eye-to-eye with their managers, except, of course, with regard to some core values like honesty and fairness and agreement as to what their strategic goals are (16:10).

Thomas S. Kuhn, professor emeritus of linguistics and philosophy at the Massachusetts Institute of Technology and acknowledged author, referred to this change as a revolution, “but it need not be a large change, nor need it seem revolutionary to those outside a single community [like the Air Force] (20:181).” The paradigm as it has existed may not

require drastic overhaul as feared by those who in positions of power (Congress and Air Force leadership), it may just need some minor adjustments that may appear radical at first.

Change, not just for change-sake, but real, cost-saving, timesaving, reliability-increasing change to meet our nation's warfighting needs can be achieved by deviating from this paradigm. Increasing reliability can improve logistics throughput and possibly even make unnecessary the need for large fleets of expensive airlift aircraft.

This can be achieved by looking at current processes in both the government and civilian logistics' world and implementing this as appropriate. A word of caution though – a one-size-fits-all should not be implemented. The individual program managers who know their system best, with oversight from above (provided the overseers are able to use economies of scale with other acquisition and logistics programs), should choose the process that will best meet the warfighter's needs while giving the taxpayer the best bang for the buck. These leaders should endeavor to search out new concepts from all sources to see how their program can be improved. They should also be given some flexibility to implement these concepts. One example of this is AFSOC's (Air Force Special Operations Command) Depot Agile Repair Team (DART) concept which will be detailed later in this paper.

Problem Statement

Currently, some Air Force logistics leaders have stated that even though the ALCs have been consolidated, they are still not as effective, as measured by time savings, cost savings, or system reliability as they can be. JV2020 even alludes to this need for change

as a requirement for the future of our forces. Therefore, this research proposes to identify and evaluate possible substitutes to some of the current logistics programs that affect aircraft availability including alternatives to depot maintenance and also, how to better move repair parts through the system to meet the warfighting vision of JV2020. This will be accomplished by looking at AFSOC's Depot Agile Repair Team (DART) program on the MH-53 helicopter, the Navy's H-60 helicopter, C-5 Lean Logistics concept, and the Army's Accelerated Logistics concept.

Research Questions

A further narrowing of the overall problem statement focuses on specific questions concerning this changing of paradigms to improve system-level maintenance – through either depots, contractors, or a combination of the two. These questions will help illuminate possible alternatives:

Question 1: How does the current depot system function to meet Primary Depot Maintenance (PDM) tasks and what laws concerning the depot impact possible alternatives?

Question 2: Was the Air Force Special Operations Command (AFSOC) Depot Agile Repair Team (DART) concept (run on its relatively small (numerically) MH-53 helicopter fleet) truly effective?

Question 3: Can an alternative logistics method, such as DART, be applied to a numerically significant fleet, say the C-5s, and prove effective?

Organization

This research paper has five chapters. Chapter 1 provides an overall background to the subject and the research questions that will be pursued. Chapter 2 is a review of literature that helps provide related insight to this research paper's topic. Chapter 3 is the methodology that frames the data collected for the research paper. Chapter 4 discusses what might be done to deal with the research questions mentioned previously and show any data collected. Finally, Chapter 5 shows conclusions and summarizes possible recommendations.

II. Literature Review

Overview

This chapter concerns itself with literature relevant to the logistics topic of finding ways to increase aircraft reliability to meet our country's warfighters' needs. These are value-added to the research at hand. To further expand, the paper will first look at some of the myriad regulatory and planning aspects associated with any military logistics issue, the breadth and scope of which are enormous and can be misunderstood easily.

After analyzing some of the important details of the laws and policy guidance, a discussion of how the current depot system functions needs to be addressed. An understanding of the entire depot system is an undertaking that would require personnel with years of experience, so this paper will focus on those aspects that apply to specific depot maintenance tasks that affect aircraft during their Primary Depot Maintenance (PDM) cycle. PDM tasks are those scheduled maintenance tasks that are normally accomplished when the aircraft is at a depot. In that vein, a look at AFSOC's DART concept, as well as the Navy's similar H-60 Integrated Maintenance Concept, might provide some interesting insight into accomplishing some PDM (or OCM for helicopters) tasks at the aircraft's home base, with the depot's concurrence, when the aircraft are already down for unscheduled maintenance. Unscheduled maintenance is the time period when unforeseen maintenance problems occur that require a specified period of time to repair. Also, as a benefit, this might coincide with accomplishing some specific PDM tasks. If it works for AFSOC's MH-53 under DART, this could possibly be extrapolated and overlaid on any other Air Force weapon system, especially those with high

unreliability rates like the C-5 Galaxy – Air Mobility Command’s (AMC) heavy lift workhorse. This is true, especially now, due to the projected shortfall of airlift in meeting the newly released Mobility Requirements Study that increased the requirement from 49.7 to 54.5 million ton-miles per day (MTM/D). The million ton-miles per day measure is derived from what is “needed to transport weapons, helicopters, and cargo to the battlefield (27:22).” The MTM/D is computed by AMC as “the product of ute rate [aircraft utilization rate], payload, airspeed, number of aircraft, and percentage of missions flying with a productive load, all divided by one million (21:n. pag.).”

Additionally, and similarly, another logistics issue that might increase aircraft reliability and in turn, increase the warfighters’ ability to accomplish their tasks, is finding ways of expediting necessary repair parts and maintenance crews to the aircraft that require servicing. The drawdown of the military as a result of the end of the Cold War has changed recently from the way the military and the depots prepared for surge operations and also involved having massive amounts of inventory on hand. There has been a retrenching that included periods of consolidation, infrastructure closures, and personnel drawdowns that have virtually eliminated any economies of scale that might have been exercised. Maintaining large inventories is costly, but so is having a C-5 sitting on the ramp at Mildenhall having to wait a week for replacement parts and a maintenance team from Dover. This aircraft is therefore unavailable to AMC, TRANSCOM, and also any warfighting CINC. Also, its downtime directly affects any funding stream to the Transportation Working Capital Fund (TWCF), which pays for AMC’s operational costs as well as other items like infrastructure and training. A possible solution to this dilemma is something akin to Just-In-Time delivery of support

forces and replacement parts – the Air Force has given this the new term, Agile Combat Support, which is one of the Air Force’s core competencies. AMC attempted to find out whether a similar concept could improve the C-5 reliability under the umbrella called Lean Logistics. Also, the Army has conducted an experiment of getting parts to the field units called Accelerated Logistics.

Lastly, although many of these new ideas might be extremely viable, there are road blocks that are unavoidable – the established paradigm within the Air Force, Department of Defense, and Congress that would seek to maintain the status quo for whatever purpose. Certainly, this is a hot-potato topic, but nevertheless, it needs to be included whenever discussion of changing those entrenched paradigms occurs. An emotionally-fraught topic must be met with logical, conclusive data revealing the advantages of any new, out-of-the-box, idea that will possibly provide a workable, cost-effective solution.

Regulatory Guidelines and Constraints

Currently, the regulatory aspects of how the depots are managed are covered by Air Force Instructions (AFIs) and Department of Defense (DoD) Directives as well as the laws set by Congress in the United States Code (USC). Related to this, but more visionary in nature, the Headquarters United States Air Force has derived what is called the *Air Force Logistics Transformation Plan FY00-07*. Additionally, material on how depots price reparables (repaired parts) offers some insight on costs and how this is managed. One must also look at other alternatives to current paradigms and AMC and RAND have completed a similar study on the C-5 and something called High-Velocity

Logistics Infrastructure as part of Lean Logistics (now Agile Logistics under JV2020). Finally, if these alternative systems are to be considered, then the source of repair would need to be established. This is called sourcing, and determines whether the system-level maintenance should be done by the depot, a contractor, or a partnership of the two.

The Air Force provides regulatory guidance in the form of Air Force Instructions (AFIs). To emphasize these procedures, all AFIs are now stamped with bold letters “COMPLIANCE WITH THIS PUBLICATION IS MANDATORY” on the first page. It would seem that any AFI is automatically regulatory in nature, but the recent conversion from Air Force Regulations to the less-strict sounding AFI has led to this labeling to ensure compliance by Air Force personnel.

All functional areas are governed by their respective AFIs and maintenance is no exception. Maintenance’s prime mission is the safe upkeep and repair of aircraft and other systems that meet this goal. Aircraft need to fly to protect the nation, project power, train and maintain currency of aircrews, transport needed supplies, and even ferry around the President. Aircraft down for anything other than scheduled, necessary maintenance adversely affect the day-to-day mission as partially described previously. For AMC, this also includes the loss of much needed funding for TWCF and the command’s ability to support the warfighting CINCs.

AFI 21-101, *Maintenance Management of Aircraft*, provides insight into the basic guidance of the maintenance functions. It stresses that “A conscientious and disciplined approach to preventive maintenance is the best method to meet that goal safely and effectively (8:5).” The goal they are referring to here is increasing aircraft availability, which is the time associated to an aircraft performing training or accomplishing

operational missions. In order to meet this goal, a certain, minimum level of maintenance must be present and trained at each airfield.

Obviously, the capability to repair all equipment on an aircraft at each base is cost prohibitive. It would include high inventory costs, high labor costs, and high capital costs to mention a few. Therefore, the maintenance structure is established under a two-level maintenance concept. This includes primarily the flightline maintenance and the depot with no intermediate shops. While the virtues of this setup are still being debated after the switch from three levels of maintenance, it is the system the Air Force employs. The third level in that system was an intermediate level that had the capability of repairing some parts at the base instead of now, when a part goes bad, it is pulled from the aircraft and sent directly to the depot to repair or replace.

Some other ideas covered include the proactive idea of preventive maintenance. “A conscientious and disciplined approach to preventive maintenance is the best method to meet that goal, [increased aircraft availability], safely and effectively (8:6).” Also, under the AFI’s discussion of two-level maintenance (2LM), the depot and flightline conceivably work together to achieve this goal as well.

Readiness is maintained by improving pipeline processes, moving reparable to depot repair centers using high velocity parts movement, and state of the art communications/computers for visibility and control of assets. Lastly, the concept enables a significant reduction in the aircraft maintenance mobility footprint (8:6).

Furthermore, since the AFI introduces us to high velocity parts movement, it leads us to the idea of Lean Logistics.

Lean Logistics is an Air Force initiative focused on improving logistics support processes by applying ‘best business practices’ across wholesale

and retail logistics functions to reduce inventories and costs and improve mission capability. It is an outgrowth of the 2LM program focusing on rapid depot repair and high velocity two-way movement of parts. Best business practices include maximum use of express carriers, expedited processing of reparable by bases to the depot, flexible and responsive repair processes that sustain quality repair, quick response contracts (both depot repair and bit and piece support), and more direct user involvement in spares distribution decisions to achieve optimum support. Lean Logistics creates a system where all segments of logistics are optimized and integrated resulting in an efficient infrastructure to support Air Force weapon systems in war and peace (8:6).

The concept of Lean Logistics sounds perfect. The parts get where they need to go as expeditiously as possible. The repairs are completed quickly and efficiently. There is visibility on the location of the part and its status. Also, the inventories are kept as low as possible to still meet demand. The concept looks great on paper and we should strive to achieve an optimum. However, there are other costs with this that are not brought out here. These will be covered in chapter 5.

Interestingly, while the Air Force is still heavily tied to its old practices of keeping work in-house, the AFI mentions innovation openly here. First, the AFI states, “The Air Force may obtain maintenance capability to repair its aircraft from different sources. These include: In-house (organic) from its operational or support commands; Other military services; [or] Commercial organizations under contract (8:5-6).” It is important to note here that the Air Force has come out and said alternatives are possible. This is key to opening the door for these alternative maintenance methods.

Additional documentation is found in AFI 21-102, *Depot Maintenance Management*. This instruction:

directs Air Force Materiel Command (AFMC) to develop and maintain a depot maintenance support programming system for depot maintenance

planning during peacetime, periods of increased tension and emergencies. It states policies for business planning, workload source determinations and organic manufacturing (6:1).

Again, the Air Force has a documented process to include the possibility of alternatives – here it’s using contractors to save money. Air Force planners currently use a Decision Tree Analysis (DTA) to determine how they source who repairs the systems – either organic or contract. This involves a very simple flow diagram that can be easily followed to arrive at the source of repair.

One step above the AFIs is the DoD oversight of logistics. This regulation has also been given an Air Force designation – AFI 21-133(I), *Joint Depot Maintenance Program*. It provides guidance on how the services and the Defense Logistics Agency (DLA) use depot maintenance support and how to assign sources of repair. Basically, it’s the same as already noted with AFI 21-102, except this regulation emphasizes “joint programs and initiatives that have objectives of increasing interservice cooperation (7:2).” Very much like AFI 21-102, there is a simplified version of the decision tree analysis to assign sourcing for either contractor or organic. However, it goes one step further by including the interservice aspect, which, conceivably, provides a higher level of oversight that should provide better economies of scale and therefore, reduce overall costs to the DoD. Furthermore, it is also interesting to note that neither decision tree analysis provides for a combined effort from the organic and contractor teams.

In what appears to be an attempt to fully grasp the enormity of the logistics community within the Air Force and to focus their efforts on the entire supply chain, Headquarters USAF has developed the *Air Force Logistics Transformation Plan FY00-07*. Also, the document is somewhat unusual as it allows for and advocates creative

thinking, not just blindly following rules and guidelines as in typical regulations. It even allows that new ideas could bring about changes to these same regulations. Its mission statement is

The Air Force Logistics Transformation effort will assess the overall Air Force Logistics Chain process from end-to-end to identify opportunities for value-added change with a focus on improving the Warfighter's support and combat capabilities in the 21st Century (4:2).

In order to meet their mission statement, the Air Force has established the Air Force Logistics Transformation Team (HQ USAF/ILM-T) that is made up of both Air Force personnel and industry representatives. For the Air Force, the team consists of “personnel with expertise in supply, maintenance, transportation, logistics planning, acquisition, and financial management (4:3).” The other half of the team, headed by KPMG, an international consulting firm with a separate U.S. subsidiary, is made up of experts in “commercial supply chain management, modeling, supply, maintenance, transportation, logistics planning, acquisition, and financial management (4:3).” Together, this team's goal is to “develop a set of plans and schedules to identify overarching transformation opportunities for value-added change of Air Force logistics processes (4:3).” Certainly then, the Air Force has recently recognized the need to have a focal point for logistics paradigm changes that will enhance its capabilities and this new Logistics Transformation Team just might be the answer.

In keeping with this concept, the *USAF Logistics Transformation Plan* has established six objectives along with how each will be achieved. Coincidentally, the main topic of this research paper closely matches the first couple objectives – optimize support to the warfighter and improve strategic mobility to meet warfighter requirements

(4:8-14). To optimize the first objective, the plan involves the following initiatives: “aircraft spare parts availability, informational advancements, reengineered logistical support concepts, and supply chain management (4:8).” An important aspect to this is how these will be measured. Previously described in Gen. Ryan’s statement to Congress, the Air Force is looking at specific performance measures. The first is spare parts funding and after “several years of under-funding for spare parts, the Air Force increased spares funding to 100 percent of the projected requirements [for FY99 and FY00] (4:9).” Second, the other performance measures deal with aircraft and their availability. These are the mission capable (MC), not mission capable for supply (NMCS), and cannibalize (CANN) rates. These measures are also defined.

MC rates are a function of personnel, policy limitations, or parts availability [as well as reliability and maintainability]. MC rates are an overall measure of aircraft readiness. When a part is not available in a Not Mission Capable for Supply (NMCS) status or cannibalize (CANN) the part from another aircraft. NMCS rates and CANN per 100 sortie rates measure parts availability. MC rates are considered a lagging indicator following the trends of more leading indicators such as CANN per 100 sorties and NMCS rates (4:10).

Quickly, a note on cannibalization – lowering this rate is the same as decreasing the amount of maintenance conceivably by half. Instead of simply removing a part from a broken airplane, going to supply and getting a replacement, then finally, putting the new part on the broken aircraft, the maintenance team (with cannibalization) also has to remove a part from another aircraft (and eventually replace it as well). Therefore, the job effectively ends up getting done twice. The second objective of improving strategic mobility will target improving warfighter support through process and infrastructure improvements. There are no existing plans to achieve this objective yet, but now that the

Mobility Requirements Study (MRS) has been released, TRANSCOM will formulate plans to meet this. Similarly, within the *Air Force Logistics Transformation Plan*, there is a section called the *Depot Maintenance Business Plan*. The mission of which is

In peacetime, it enhances readiness by efficiently and economically repairing, overhauling and modifying aircraft, engines, missiles, components, and software to meet customer demands. During wartime or contingencies, it surges repair operations and realigns capacity to support the warfighter's immediate needs (4:46).

Both Air Force Materiel Command (AFMC) [and] Depot Maintenance (organic and contract) operations accomplish repair and overhaul. Customers pay for depot maintenance repair when the item is needed. Depot maintenance operates on the funds received through the sales of its products and services (4:46).

In order to meet this, there are 13 objectives that have been identified. Those directly tied to this research include reducing total flow days, reduce average customer price, and contract depot maintenance management (4:48-50). Flow days are the number of days an aircraft are being worked on by the depot/contractor. Therefore, these aircraft are unavailable for missions or training. Also, as referred to above, the customer pays the depot for work and the monies go into something called the Working Capital Fund. Congress established the funds with the goal being to make the services more business-like in how they operate by “reducing depot maintenance cost and improving depot maintenance efficiency (11:4).” However, these “are complex and challenging tasks that are compounded by force structure downsizing (11:4).” Third, the need for contractors has been identified as a way to meet the Air Force's objectives of meeting the warfighter's needs while simultaneously using the most cost-effective method. Finally, the depot maintenance plan can be detailed as follows:

First, it must support the needs of combat forces of today and tomorrow through assured peacetime readiness. Second, it must retain a reserve capacity to surge to meet contingency operations. Next, it must provide best value to the taxpayer by maintaining strong public and private sector maintenance capabilities and allocate work through the use of best value assessments and formal competitions. Finally, it must comply with all legislative commitments (4:58).

Speaking of legislative commitments, in addition to the military regulatory aspects of depot maintenance, the U.S. government, through the Congress, continually passes legislation, that once signed into law, must also be adhered to by the military. Title 10 of the U.S. Code concerns the military and its operation. The sections of Title 10 that deal with depot-level repair provide overall guidance to the DoD on how to accomplish the tasks. It also defines terms, sets exceptions, dictates annual reports the military must send to Congress, sets limitations, provides for waivers, establishes cost comparison activities, sets the need for core logistics capabilities, and also, places limits on the percentage of funds (currently 50% - U.S. Code: Title 10, Section 2466) allowed for contracted work. As an aside, U.S. Code, Title 10, Section 2466, is normally written as 10 USC 2466. For the remainder of the paper, this is how it will be shown. A further in-depth study of these documents is necessary, as they will establish parameters by which the alternative methods can be utilized.

Some of the sections of Title 10 of the USC that deal with this topic include: **section 2460** - Definition of depot-level maintenance and repair; **section 2461** – Commercial or industrial-type functions: required studies and reports before conversion to contractor performance; **section 2462** – Contracting for certain supplies and services required when cost is lower; **section 2463** – Collection and retention of cost information

data on converted services and functions; **section 2464** – Core logistics capabilities; **section 2466** – Limitations on the performance of depot-level maintenance of materiel; **section 2469a** – Use of competitive procedures in contracting for performance of depot-level maintenance and repair workloads formerly performed at certain military installations; and lastly, **section 2474** – Centers of Industrial and Technical Excellence: designation; public-private partnerships. As one can see, there are a number of these related sections that must be adhered to by the military. This can be especially difficult in that the Congress can, and often does, change the law. This can play havoc on long-term plans.

A brief description of each, other than its title will also help elaborate these laws. Section 2460 not only defines depot maintenance and repair, but also provides exceptions to the law. The Air Force has incorporated this definition as well into its instructions (see Appendix A for a glossary of terms). Section 2461 details reporting requirements before using contractors. It's very specific about what is necessary in terms of economic analysis as well as listing those waivers and wartime exceptions that change the reporting procedures. In section 2462, when a service or item can be procured at a savings to the government, it will be accomplished if allowed by other laws. Also, the costs must be realistic and fair. Mostly, this section applies to ordinary supplies and services (like office supplies and landscape maintenance for example) that are not core competencies of the military. Section 2463 basically tells the DoD how long they must audit contractor performance and how long the data will be retained. Section 2464 is an important section in that Congress directs the Secretary of Defense (SecDef) to identify and maintain a core logistics capability “to ensure effective and timely response to a mobilization, national

defense contingency situations, and other emergency requirements (10 USC 2464(a)).”

Also, it states that the SecDef can not contract out core capabilities. However, the SecDef is allowed to waive this provided that the “workload is no longer required for national defense reasons (10 USC 2464(b)(2)).” As the paper shows later, there is some dispute between Congress’ audit watchdogs, the General Accounting Office (GAO), and the DoD on what is truly a core capability for the Air Force, implying that it is using this to get around section 2466 which is famous for the 50-50 rule. As for section 2466, it is the limiting factor for how much non-core competencies can be contracted out to private industry. It states that

not more than 50 percent of the funds made available in a fiscal year to a military department or a Defense Agency for depot-level maintenance and repair workload may be used to contract for the performance by non-Federal Government personnel of such workload for the military department or the Defense Agency (10 USC 2466(a)).

Later, this paper, discusses the enormous problems for the depots that are caused by this language. From there, the next section, 2469a, discusses depot consolidation and the changing workloads caused by the closures of military depots. Lastly, section 2474 notifies the SecDef that all military depots are to be designated Centers of Industrial and Technical Excellence and “to reengineer industrial processes and adopt best-business practices (10 USC 2474 (a)(2)).” For the Air Force, the *Air Force Logistics Transformation Plan FY00-07* accomplishes this task.

Depots

In just about every piece of literature that discusses the military depot system, there is a section dealing with how our country went from a status as a fully mobilized nation in World War II, through a quick downsizing, followed by a just-as-quick near mobilization for Korea and the Cold War. Then, there is the standard winning-of-the-Cold War-downsizing, peace-dividend verbiage that we all have grown accustomed to since the early 1990s. The intent here is to focus on what was really happening – a change in the paradigm. It is certainly not to belittle the achievements of our people and the nation. But, times are changing and the BRAC was a step in the right direction to making change a reality. Less demand for the depot services from the downsized Air Force aircraft inventory caused an excess capacity capability in the depots. This is analogous to keeping high inventory levels – it costs too much to maintain. Therefore, as good stewards of the taxpayer dollars, Congress, with input from DoD, used BRAC to eliminate the excess. Another series of events caused the Air Force to change how they thought. This included the buy-in of business practices to better manage the assets. These included Total Quality Management, Supply Chain Management, Operational Risk Management, etc. Additionally, Congress established funding that allows the military to only spend specific dollars for specific activities. This greatly limits the budget control by each service for what they think is best. Therefore, with a limited discretionary budget, this forces the services to find the absolute best way to get a quality product to the warfighter at the lowest possible cost. In most instances, this can be achieved through privatization. Privatization causes many problems however.

Depots are big business. “DoD annually spends about \$15 billion on depot maintenance activities at 29 major defense depots and at about 1,300 private contractors (13:1).” Additionally,

The primary depot maintenance workloads assigned to DoD depots are those required to sustain core maintenance capabilities. Core maintenance capability is the skilled personnel, facilities, and equipment maintained at organic defense depots to meet the readiness and sustainability requirements of the weapon systems that support the Joint Chiefs of Staff contingency scenarios. Core maintenance exists to minimize operational risks, guarantee readiness of weapon systems in war or contingency situations, and ensure a ready and controlled source of technical competence (13:1-2).

The GAO, in a 1996 report to the Senate Armed Services Committee, questioned DoD policy of “determining whether mission essential workloads previously determined to be core and performed in public depots can be outsourced at acceptable levels of risk (13:9).” Obviously, the less aggregate number of core activities there are, the less the DoD needs to maintain the overhead associated with it and can thereby save money [or spend it elsewhere]. Another problem on the horizon concerning core capabilities is the advent of the newest weapon systems that contractually have the manufacturer providing what is essentially depot repair work. The C-17 is a prime example.

Along these lines, the Air Force is required to report on Total System Performance Responsibility. These are weapon systems where the primary contractor supports the depot functions. A recent Air Force report (with F-117, KC-10, and C-17) states that “logistics support provided by contractors had been equal to or better than support provided by government sources (14:11).” GAO disputes this assertion. They explain that these are relatively new weapon systems and they are smaller fleets

compared to older systems (F-15, F-16, KC-135, C-5, and C-141). The older systems tend to have a more complex supply chain and more maintenance needs as well (14:11). Also, GAO was unable to determine whether the statement on contractor support being equal or better was true or not. As a possible warning to the future of the depots, GAO quoted

a 9 February 2000 memorandum from the Ogden Air Logistics Center to Headquarters, Air Force Materiel Command that stated: Infusion of new technology workloads from new weapon systems is essential to maintain core. Therefore the future of the [air logistics center] is contingent upon acquiring workloads in each technical repair center that will continue to provide a viable organic source of repair for the using commands. If an [air logistics center] is determined core or best value in a particular technology, then any new weapon system acquired that has the associated technology should have the respective core allocation from day one of the sustainment life cycle. The core determination is weighted heavily towards older high surge workloads. Depots are provided new workloads often only after the original equipment manufacturer loses interest (14:13).

Clearly, there is at least two ways of looking at this statement. First, the person is trying to hold on to the current paradigm and simply create more work for the depot.

Admirably, they do however discuss best value. Second, the person could be trying to keep within the boundaries concerning core workloads as established by 10 USC.

Lastly, the boundaries of 10 USC 2466 limit each service from exceeding 50 percent of the total funds provided each year to private maintenance contractors. Over the past few years, the percentage attributed to this has increased noticeably. Figure 3 and Table 1 shows graphically and numerically the increasing amounts of all three major services including projections out to the year 2004.

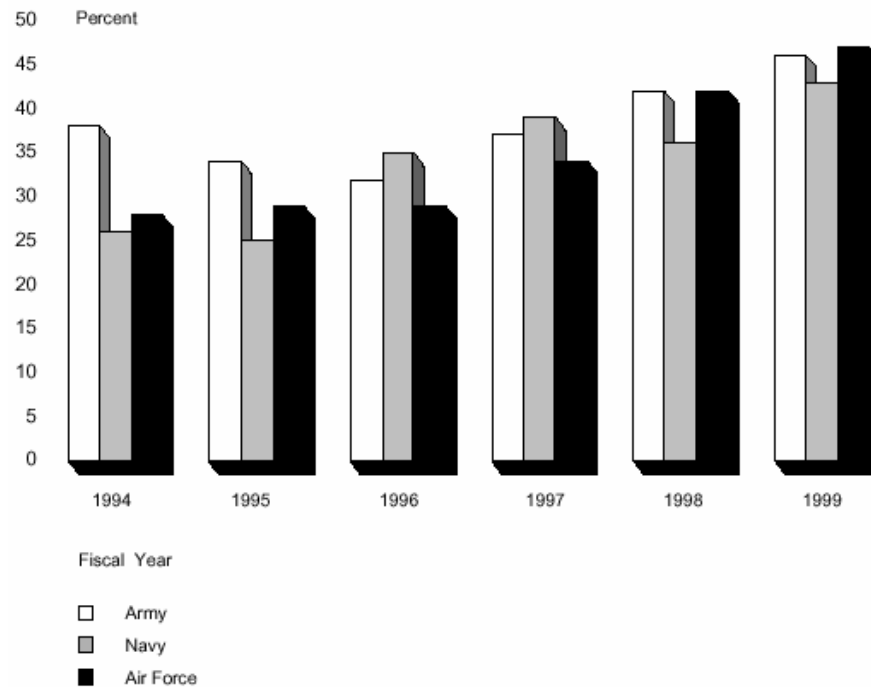


Figure 3. Percentage of Depot Work Performed by Private Sector (15:8)

Dollars in millions by fiscal year		1998	1999	2000	2001	2002	2003	2004
Army								
Public		\$1,011.1	\$1,010.3	\$1,084.3	\$1,033.7	\$1,098.2	\$1,126.8	\$1,189.2
		58.3%	54.3%	56.6%	57.2%	54.0%	53.9%	54.5%
Private		\$722.8	\$849.5	\$832.7	\$772.5	\$935.5	\$963.2	\$992.1
		41.7%	45.7%	43.4%	42.8%	46.0%	46.1%	45.5%
Total		\$1,733.9	\$1,859.8	\$1,917.0	\$1,806.2	\$2,033.7	\$2,090.0	\$2,181.3
Navy								
Public		\$4,040.1	\$3,898.7	\$4,290.4	\$3,884.1	\$4,358.5	\$4,997.3	\$4,584.8
		63.6%	57.0%	59.6%	58.4%	61.5%	65.1%	61.7%
Private		\$2,310.2	\$2,938.4	\$2,908.4	\$2,768.1	\$2,733.8	\$2,682.1	\$2,851.8
		36.4%	43.0%	40.4%	41.6%	38.5%	34.9%	38.3%
Total		\$6,350.3	\$6,837.1	\$7,198.8	\$6,652.2	\$7,092.3	\$7,679.4	\$7,436.6
Air Force								
Public		\$3,335.1	\$3,281.9	\$3,130.3	\$3,292.3	\$3,573.2	\$3,601.9	\$3,681.7
		58.2%	53.1%	50.5%	52.0%	52.7%	52.1%	52.0%
Private		\$2,397.6	\$2,902.7	\$3,066.6	\$3,041.6	\$3,206.7	\$3,310.2	\$3,396.4
		41.8%	46.9%	49.5%	48.0%	47.3%	47.9%	48.0%
Total		\$5,732.7	\$6,184.6	\$6,196.9	\$6,333.9	\$6,779.9	\$6,912.1	\$7,078.1

Source: DOD data reported to the Congress.

Table 1. Reported Depot Maintenance Workload Allocations (15:6)

“As permitted by 10 USC 2466, the Secretary of the Air Force waived the 50 percent limitation on private sector work for fiscal year 2000 and notified Congress that a waiver could also be required for 2001. (15:18)” Given the current trends for the as yet undetermined source of repair for future new weapon systems, like the F-22, as well as the Joint Strike Fighter which might comprise 75 percent of the U.S. fighter aircraft in the future, the Air Force is moving toward a decision for total contractor support. It is unlikely the Air Force can resolve its 50-50 imbalance and meet the requirements of 10 USC 2466 (15:21).

Maintainability

Before proceeding on to cover DART and PDM, Lean Logistics, and Accelerated Logistics, a small, but important tool must be added to understand total life-cycle costs and the affect it has on the depot and flightline maintenance and also the remainder of the logistics support. The important point for any manager is controlling costs. For the military and Congress, this equates to being good stewards of the dollars the taxpayers provide to the government.

For the logistics community, controlling costs starts at the very beginning of any system’s life cycle. Interestingly though, analyzing the entire end-to-end costs of an acquisition has been in vogue only recently. Before, the acquisition experts would go out and select say, a new weapon system, and then, once the initial research and development as well as production costs were derived, the ball would be punted over the fence to the logistics side to determine the ongoing maintenance and eventually, disposition costs. This was not a very cost-effective system and the two sides were not working together

well to achieve a decent end result (money-wise). Recognizing this, AFMC was created by putting these two factions under one umbrella and the Air Force moved away from this inefficient system toward more of an end-to-end cost analysis system. The new buzzword for this is cradle-to-grave when referring to life-cycle costs. Acquisition personnel are now required to consider these life-cycle costs when determining the acquisition of a system. The generic model for this process comes from *Introduction to Defense Acquisition Management* and is shown here:

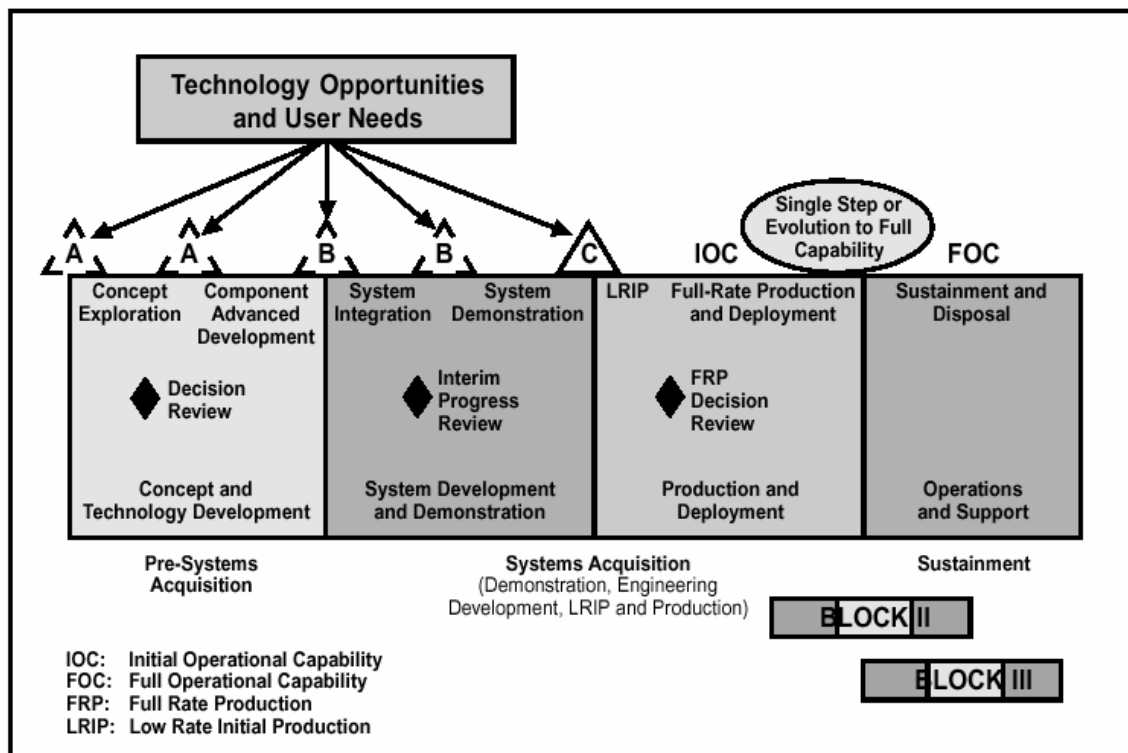


Figure 4. Defense Acquisition Management Framework (17:53)

Additionally, Benjamin S. Blanchard, has written numerous textbooks on maintainability. Among his findings, he states,

In analyzing long-term costs (i.e., life-cycle costs), experience has indicated that a large percentage of the projected cost for a given system

can be attributed to the maintenance and support activities associated with keeping that system available and operating throughout its planned utilization period. For many large-scale systems, the cost of system maintenance and support often ranges from 60 to 75% of the overall life-cycle cost of the system. In evaluating “cause-and-effect” relationships, much of this cost can be traced back to many of the design and management decisions made during the early stages of the conceptual design phase (1:vii).

Therefore, for all new systems that will be considered for the military, the highest cost savings are attributed to prior planning. Blanchard also goes on to say that

for those systems already developed and being utilized by the consumer, the potential for improvement (in terms of increased effectiveness and reduced life-cycle cost) through the incorporation of additional maintainability features in the existing design is [still] great (1:viii)!

Blanchard stresses the support and maintenance aspect of any life-cycle cost and calls it the iceberg effect as illustrated by figure 5. He also is emphasizing the danger in not recognizing the entire situation.

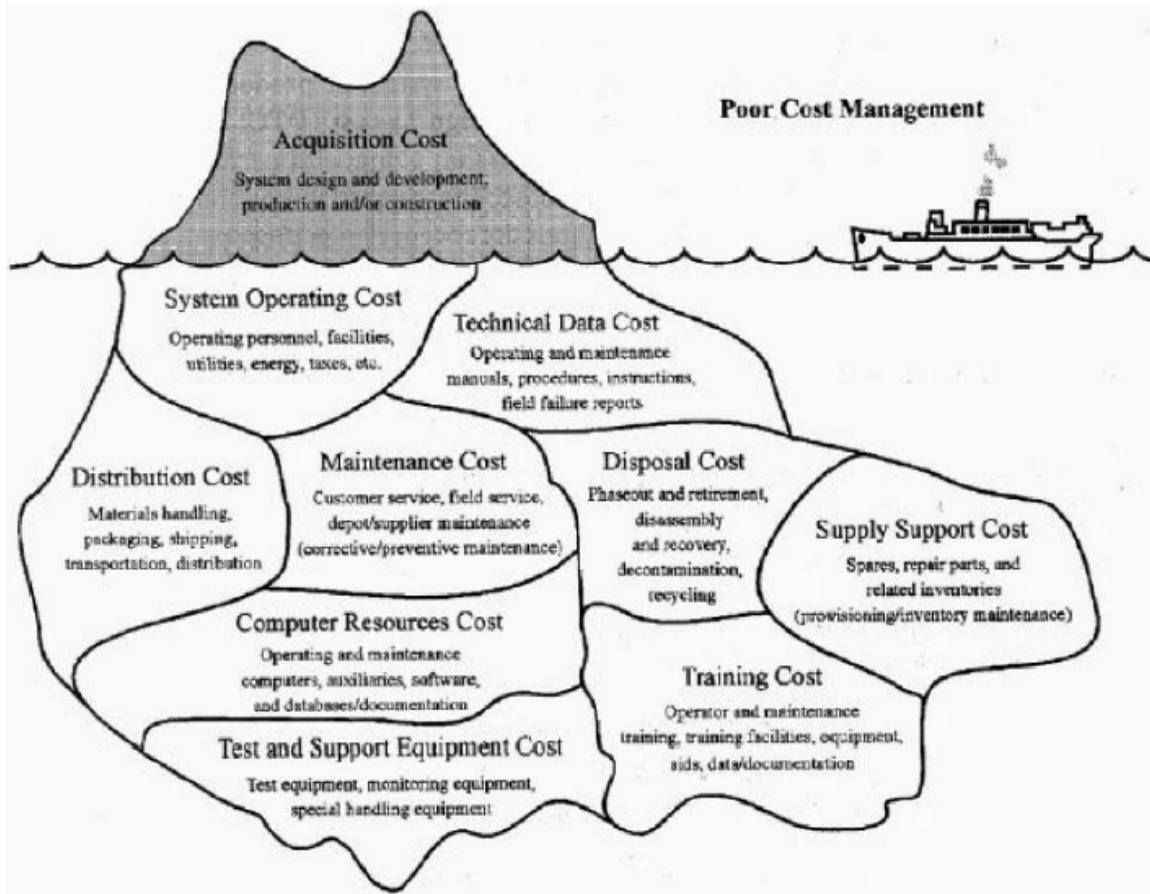


Figure 5. Total Cost Visibility (2:7)

To summarize, it is essential that all life-cycle costs be considered. A well-run program will allow for ease of maintenance and quick supply of replacement parts to then meet the needs of the warfighter. Having provided a background of logistics, now the paper will introduce some recently developed concepts.

Depot Agile Repair Team (DART)

In the mid-1990s, a combination of problems severely hampered the MC rates of the MH-53 helicopter for AFSOC. One was the Base Realignment and Closure (BRAC) of the Pensacola Depot and its workload moving to the Cherry Point Depot which caused

work delays on aircraft either in Florida or scheduled for North Carolina. Also, “the transition plan called for the first five OCMs at Cherry Point to take up to 200 days” (22:n. pag.) which was beyond AFSOC’s schedule of 180 days. This was primarily due to the lack of knowledge of the workers at Cherry Point of MH-53 OCM tasks. An important concept called the learning curve was never included in Cherry Point’s improvement plan and they were going to continue to set the flow days at 200 until questioned by the then AFMC PAVE IPT Lead, single manager, Lt. Col. Mueller. The second important problem causing the low MC rates was lack of spare parts. Third, the fleet was also apparently showing its age by having unforeseen age-related maintenance problems like heater fires.

Eventually, the problems compounded and the MH-53 program went from bad to worse. Cherry Point promised AFMC they would improve, but they were unable to overcome their change in workload caused by Pensacola’s closure.

By the Spring of 1996, flow days had ballooned to a high of 284, with the average breaking the 265 barrier! They were pouring 12,500 hours into each plane at nearly \$100 an hour... OCMs were hopelessly late and over a mil[lion] per plane (22:n. pag.)!

Apparently, the MH-53 fleet had undergone a Service Life Extension Program (SLEP) the previous summer and received new hydraulic systems, 80 percent skin replacement, new conduits, wiring, and more. AFMC was confounded as to the increase in flow days on basically partially new aircraft due to the SLEP. Also, every flow day past the 180 day point greatly affected AFSOC’s ability to train and process their missions. This in turn affected aircrew currency and proficiency, maintenance training and scheduling, and ultimately, the warfighters by not allowing them the option to use these assets.

The SPO director, Col. Mason, and Lt. Col. Mueller visited Cherry Point in the summer of 1996 to see first-hand what was causing the unacceptable increased flow days. As was, and still is, required by regulation, any aircraft brought into a depot needed to be operationally ready. The job of the depot is to “provide material maintenance or repair requiring the overhaul, upgrading, or rebuilding of parts, assemblies, or subassemblies (10 USC 2460(a)).” Apparently, Cherry Point did not have a plan in place other than to completely overhaul the aircraft – even only a year after its SLEP! Working together, although this “was met with no enthusiasm” (21:n. pag.) by the depot production management, AFMC and Cherry Point eliminated unnecessary work, synchronized resources, decreased CANN on aircraft awaiting other parts, improved repair instructions, and improved shop scheduling (queuing). After a few iterations (the learning curve concept),

in May of 97, I [Lt. Col. Mueller] flew home on an OCM aircraft that had been done “start to finish” in 90 days, for around \$800K... a 66% percent reduction in flow days and 33 percent reduction in cost... while accomplishing 100 percent of the engineering based work spec (22:n. pag.)!!

One might have thought this was a resounding success story for AFMC and Cherry Point, but there was something that stood out about it all. Lt. Col. Mueller observed that of all the work that was accomplished by the depot, it “did not require lots of special tools, fixtures, or other depot unique items (22:n. pag.).”

After mulling it over, a few things came to light. First, most of the depot OCM tasks could be completed at the aircraft’s home base. Second, an analysis of how the aircraft were used over a four year time period revealed that “enough down time exists to

man load the work spec during unit scheduled maintenance, having the DART workforce and unit level GIs working side by side (22:n. pag.).” In layman’s terms, they could hire a stand alone workforce, a contractor in this case, who’s sole purpose was to complete these depot OCM tasks on the aircraft while it was down for scheduled (even unscheduled) maintenance. This would be done on a non-interference basis with the organic (AF) maintenance crews. The problem would be to remain within the guidelines established by law in 10 USC 2464 and 2466.

Under U.S. Special Operations Command, USSOCOM, there is an allowance for them to be able to contract to a Government Owned/Contractor Operated (GOCO) activity with a \$650M ceiling. In essence, Lt. Col. Mueller was able to show his “expenditures as government to government and based on 10 USC 2464 and 2466, [and] at the time, this was in bounds (22:n. pag.).”

Since then, the DART program has grown to include each home base of the MH-53 PAVE LOW helicopter. AFSOC/LG is also looking at ways to develop a DART for the C-130 Hercules and possibly the new, but already beleaguered CV-22 Osprey.

H-60 Integrated Maintenance Concept

Similar to AFSOC’s dilemma with the MH-53 and its DART solution, “the Navy is proposing a program termed Integrated Maintenance Concept (IMC) for its fleet of H-60 SeaHawk helicopters (18:1).” The Navy was concerned about lowering costs, maintaining a balance to keep as many aircraft available for operations as possible, getting a quality product, and keeping a depot maintenance capability.

Charles S. Hatcher, Jr., in his Naval Postgraduate School Thesis, *An Analysis of Depot Level Maintenance for the H-60 Helicopter Under and Integrated Maintenance Concept*, thoroughly examined traditional depot methods. He gathered historic data from Pensacola Naval Aviation Depot from 1987 to 1995, modeled the data, and concluded that there was little correlation between labor costs and aircraft age or labor costs and aircraft employment. He did conclude from his linear regression analysis that “aircraft age is, however, statistically significantly in explaining material costs (18:43).” He states later that many more variables could be added to increase the accuracy of his model that would better estimate the costs of depot maintenance.

Also interestingly, Hatcher provides some insight into some possible future Air Force problems. The H-60 receives scheduled inspections at certain milestones and if they fail, they are sent to the depot for repair. If they do not fail, they are kept in the fleet and are therefore available to the warfighter. The H-60 is apparently not failing at the rate it was predicted to fail. For the depot to establish its rates, as required by the Working Capital Fund, the unexpected success of the H-60

complicates other processes such as cost negotiation, determining overhead rates, and scheduling of parts required during the SDLM [Standard Depot Level Maintenance]. These issues are the source of a general concern that there is a ‘bow-wave’ of deferred aircraft that will eventually fail, creating SDLM demands that exceed the current throughput capacity [of the depot] (18:16).

Quite unlike his Air Force counterparts working with the MH-53, Hatcher’s conclusions include maintaining a constant flow of aircraft to the depot to minimize the variances in price, reverting to a system based on time versus on-condition, and increasing the fleet’s ability to perform maintenance at sea. For explanation, on-condition maintenance

(OCM) is a program where under regularly scheduled inspections, the status of the aircraft is determined and either sent to the depot or remains at its base for operations.

C-5 Lean Logistics

RAND, under contract with the Air Force, completed research into logistics and created a report, published as a book titled, *Lean Logistics, High-Velocity Infrastructure and the C-5 Galaxy*. The author, Timothy L. Ramey, says that Lean Logistics “considers the effect of radically shortened spare-parts transportation and repair times on performance of the C-5 Galaxy airlift aircraft (24:xi).” This study was undertaken to help show how to bring the maintenance costs down not only in monetary terms, but also opportunity-lost costs associated with the C-5 availability. A C-5 on a mission is meeting three sets of needs: aircrew and maintenance training and proficiency; providing funds for the Transportation Working Capital Fund which pays for the infrastructure and operations of mobility assets; and most important, helps meet the warfighter’s goals. On the other hand, a C-5 broken on the ramp somewhere overseas is only a liability. The main difficulty of any air mobility aircraft is that they tend to fly to locations where there are no fixed facilities in place to service them. Whereas for fighter and bomber aircraft, who tend to operate out of more permanent locations and when they do go outside the CONUS, they bring large amounts of logistics support with them. One of the goals of Lean Logistics is to shorten the time from when an aircraft breaks down in the system to the time it gets fixed.

The author used “a simulation model of C-5 fleet operation and support using the latest version of RAND’s DynaMETRIC [see Appendix A] (24:xi).” Prior to completing

the task, the “model was reviewed by AMC and was validated by comparing simulated performance of the C-5 fleet under today’s infrastructure with historical performance as reported by AMC (24:xi).”

As mentioned previously, Lean Logistics is the Air Force’s attempt to increase logistics’ effectiveness through best-business practices.

An important element of Lean Logistics is a *high-velocity infrastructure*: A provider of goods or services that takes less time to respond to a consumer’s needs tends to be less affected by variations in consumer demands, to be more effective in the face of production and demand uncertainties, and to need less work-in-process inventory (24:1).

Throughout the RAND report, the author explains that “high-velocity logistics infrastructure emphasizes speed of processing over mass of inventory (24:2).”

Maintaining a large inventory can be cost prohibitive. However, enough parts must be on hand to meet ongoing operations. Also, it is difficult to keep a manufacturer around for a limited run of products. It is not financially sound. Therefore, the Air Force must balance keeping just enough parts on hand with maintaining their initial supply. Now, most parts can be repaired at the depot, which saves the Air Force from having to go back to the manufacturer. However, the study found that

whereas it takes, on average, 60 to 90 days for Air Force logistics processes to turn a broken repairable component into one ready for issue, a high-velocity infrastructure might produce that repaired component in 5 to 10 days (24:2).

This is problematic of the whole Air Force and not just the C-5. However, one can see how having a C-5 broken in South Africa could easily extend the repair timeline. This is where a high-velocity infrastructure would help greatly.

A synopsis of the author's conclusions is:

C-5 performance would be improved by a high-velocity infrastructure [an alternative method]; CONUS and depot portions of the infrastructure would benefit most from the changes examined here [making the politicians happy by keeping the depot workers employed]; inventory reductions over time; [lastly] different weapon systems will respond differently to implementation of Lean Logistics initiatives. Generalizing specific results of this study to other weapon systems may be problematic (24:xiv).

Obviously, the author believes that this alternative method of shortening repair times and spare part delivery times will provide what he terms High-Velocity Logistics. Again, the thought should be how this improves the logistics' process to meet the warfighter's needs, if it is cost effective and viable, then it must be considered.

Army Accelerated Logistics

The Army was experiencing problems with its logistics system meeting its customer's needs. No longer could they rely on massive inventories that were prepositioned. As with the other services, the Army was forced to reduce its inventory levels and figure a way to provide parts quickly, reliably, and cost-effectively. As it stood, "Army mechanics would wait on average a month for spare parts from distant supply depots in order to repair a 'down' weapon system. Delays occurred in all segments of the process, and response times varied from month to month (28:xi)."

As with the Air Force and its logistics requirements, the Army brought RAND on board to help analyze and provide alternatives to their current logistics system. Through its analysis, the author from RAND, Mark Y.D. Wang, found out that

Army installations received packages through a mix of delivery modes, including small-package air, small-package surface, less-than-truckload,

and truckload deliveries. This delivery mix wasted both resources and time, and it made the process more unpredictable. Scheduled trucks addressed the real task – moving a large quantity of materiel from one place to another (28:xii).

Eventually, using RAND's ideas, the Army was able to “dramatically streamline its supply chain, cutting order and ship times for repair parts by nearly two-thirds nationwide (28:xi).” Like the Air Force's Lean Logistics, the Army's new Accelerated Logistics emphasized speed over mass. Again, the days of Cold War stockpiled, cost prohibitive inventories were gone. A new paradigm needed to be established.

RAND analyzed every aspect of how a part is ordered and eventually received. They observed how the part was ordered, how the order was received and processed, how the part was collected for shipment, by what mode (and how it was determined) it was to be shipped, and how it was received at the base. Bottlenecks were identified at every step in the process. Also, RAND found that “every Army installation and unit does things somewhat different, even if they have identical missions by doctrine, so process improvements at one location may not address issues elsewhere (28:15).”

The test RAND set up for this logistics concept involved Fort Bragg, NC and the Defense Logistics Agency (DLA) supply depot in Susquehanna, PA. A baseline was established from recent historic data from which to compare. Once all the analysis and processing recommendations were in place, which already reduced the order-to-receive times, a scheduled truck delivery system was implemented. A benefit to this was “long-term contracts for daily scheduled truck service were cheaper than aggregated package-by-package charges (28:26).” For the Air Force and the other services, this example could have ramifications on the newly developed WorldWide Express delivery system.

This system is contracted to provide an express parts delivery capability to most of the world. Further, on the truck loading, the truck was loaded in reverse order to how it would be delivered, thereby saving time on the receiving end. Also,

drop-off times were set at each location, where a crew of soldiers stood ready to unload truck cargo. For the driver, there is less wasted time driving and waiting at unprepared delivery points. For the soldiers, their responsibility to receive shipments is confined to a short period every day, rather than waiting for deliveries that may or may not arrive (28:28).

Therefore, this gives them more time to complete their other tasks or put another way, allows them to complete more tasks.

Very much like Lean Logistics, Accelerated Logistics has applications beyond its original intent that most certainly could benefit all the services and by doing so, meet the needs of the warfighters.

Summary

Prior to stepping through the process of researching alternatives to current logistics paradigms, an understanding of the logistics system and how it exists under regulation and law needed to be reviewed. Once that was completed, an analysis of material on related projects to possibly garner additional insight was completed. Also, additional material that explains how decisions are made on who gets sourced for contracts helps explain how business is transacted. These all allow for an informed method by which to develop alternative possibilities to the logistics system as it exists today.

III. Methodology

Research Approach

This research paper will use the three research questions to help determine if changing some aspects of the current depot maintenance and logistics paradigms is to our nation's benefit. To accomplish this, a mostly qualitative approach was taken through an extensive review of literature. Most quantitative data acquired will come from these same sources with some coming from Air Force maintenance organizations. Other sources of data include published material on the Navy H-60, the Army's Accelerated Logistics concept, and the Air Force's Lean Logistics process.

Although the paper is qualitative in nature, generalized comparisons should show a relationship between a possibly truly effective paradigm-breaking program (the MH-53 DART) and other weapon systems – say, for example, the C-5. Eventually, certain aspects might be applied to all weapon systems as the program managers become aware of the potential savings. While it is virtually impossible to superimpose the details of one program onto another, the concepts of how they go about completing the depot system maintenance at their home base are the same.

In looking at the data collected, there needs to be a historic look at recent depot history, how maintenance and the depots operate, and what U.S. laws describe how depot work is allowed to be accomplished.

Secondly, from qualitative analysis of discussions with the maintenance teams, program managers, logistics officers, and contractors, the research should be able to determine if there was indeed a strong correlation between DART and the increased

aircraft availability rates and program cost savings or if it could have been due to some other cause. Here, aircraft availability rates are the time that the aircraft is actually available to fly.

Using the MH-53 as the control group, direct probable inferences could be made to the C-5, or other aircraft, to determine possible cost savings from minimizing depot flow days. Depot flow days are the time the aircraft is at the depot. The minimum gain the research will show is that given binding legal constraints, even small aspects of this program might be applied to reduce depot flow days and save dollars. As a result, this style of maintenance will be of benefit to the Air Force and the U.S. taxpayer. For the logistics aspect, similar benefits might be able to be derived from using these new concepts, even on a limited basis. All in all, these could be effective tools for the leadership to meet the warfighter's needs.

Lastly, political considerations will also need to be explored as this could potentially affect certain congressmen's districts. Also, historically, the military has not been receptive or quick to change. This paper needs to spell out the possible benefits to be given any thoughtful consideration.

Expected Results

If the research shows that DART is indeed a viable program as an alternative to the current paradigm, then the potential for increased aircraft availability rates (minimizing depot time) and cost savings can be inferred to be reasonably high, especially for a large fleet of aircraft like the C-5 or even F-15s. Additionally, for the logistics portion, a plan delivering these important supplies and parts to the warfighter

within cost-effective and timely constraints could be what is needed for the future.

Therefore, Air Force leadership should seriously consider the ramifications of not implementing these new concepts – break the paradigm.

IV. Data Description and Analysis

Depot Data

The number of congressionally-directed audits by the GAO concerning depot maintenance, depot privatization, depot workload privatization, contractors doing depot-type work, and depot management have increased since the early 1990s. GAO's function, as the legislature's watchdog organization, is to collect data, analyze it, and verify compliance with existing laws.

In May 1995, GAO was asked by the Chairman of the House Committee on National Security to "comment on the report by the Commission on Roles and Missions [(CORM)] of the Armed Forces that recommended the Department of Defense privatize its depot-level activities (12:20)" Even though the CORM suggested a 20 percent savings and ability to maintain the depots' readiness and sustainability through privatization (12:1), the House National Security Committee was concerned. GAO found that

the CORM assumed a highly competitive and capable private market exists or would develop for most depot workloads. However, we [GAO] found that most of the depot workloads contracted to the private sector are awarded noncompetitively – mostly to the original equipment manufacturer (12:1).

The GAO noted that the CORM's basis for the savings was a derivative of savings as a result of the Office of Management and Budget's (OMB) Circular A-76. "A-76 lays out how the government outsources jobs. It requires that agencies conduct competitions between federal employees and vendors [contractors] (10:n. pag.)." On the other hand,

the CORM wants to solely use private sector competition for privatization. GAO admitted savings do result from A-76 conversions, but emphasized “the [less than expected] savings resulted from the competition rather than from privatization (12:2).” Recently, in December of 2000, the Pentagon put a stop on any Air Force outsourcing until a review of A-76 problems at Lackland Air Force Base is made.

In the final analysis, GAO, in opposition to the CORM,

found that public-private [like A-76] depot maintenance competitions have resulted in savings and benefits and can provide a cost effective way of making depot workload allocation decisions for certain workloads. The beneficial use of such competitions could have significantly more applicability than the Commission assumed (12:3).

This statement by GAO can be viewed as a hindrance to what appears to be an overall Air Force trend toward privatized contractor support as evidenced by the recent and continued growth in this area.

Depot Agile Repair Team (DART)

From all accounts, DART has shown some very positive aspects. “At DART inception in 1997, the MH-53J MC rate was 56.9 percent, in 1998, it increased to 63.6 percent, in 1999, it went to 69.4 percent and in FY00, it reached a record high 80.5 percent (22:n. pag.).” This was in a fleet where the departure of even one aircraft to maintenance from operations noticeably affected the overall MC rate. By performing depot level tasks on a non-interference basis, the Air Force has been able to realize great savings. DART is now able to accomplish 21 of 23, or 91.3 percent, PDM tasks and is looking to acquire the capability to complete the remaining two. Col. Mueller points out

that by using DART, and with DART labor rates of \$40 per hour versus \$90 per hour at the Cherry Point depot, over a four or five year period of the execution of the 8500 or so hours, the price would be \$340K vice \$765K for the OCM work spec (22:n. pag.). That is 45 percent cheaper (72 percent cheaper than the high-water mark of \$1.2M (22:n. pag.).

DART has given AFSOC greater flexibility in meeting its mission to the warfighter. Depot flow days have been reduced from 140 down to 35 and this represents mostly painting tasks.

The OCM input for FY00 decreased from 7 to 3 aircraft. [This is a direct result of DART and can not likely be attributed to any other aspect]. The DART also completed 22 unscheduled depot repair actions in FY99 (T.O. 00-25-107 Request for Depot Assistance). Accomplishing this work at the unit avoided 44 weeks of aircraft downtime, two weeks per aircraft (prep/transit and wait time). Nine of the 22-repair requests were from overseas units. Of these 9 overseas requests, 5 would have required airlift support to transport the aircraft to the depot (19:n. pag.)

Additional numbers from RAF Mildenhall of the maintenance unit that works on the MH-53 show continued success attributed directly to DART. There was no other process improvement action running concurrent with DART. Now, as mentioned in Gen. Ryan's statement to Congress, funding has increased to 100 percent in the last couple years for spares. This might be another factor in aircraft availability. However, the research also revealed a couple year time lag from funding to actually having the parts on hand.

The DART concept has taken a beaten down weapon system and turned it around. It is now exceeding any past MC rates on a system that is over 30 years old. Aircraft do not get better with age. As they age, they require more time for maintenance to keep operationally viable. Again, there was no other process apparent that might have

contributed to the increased aircraft availability other than DART. The maintenance structure and personnel capabilities were essentially the same over time. Funding for spares had increased, but DART had already made inroads prior to the spares being available. The apparent success of DART is well received by AFSOC and they are currently looking to use this concept on the new CV-22 Osprey Tiltrotor aircraft for the future.

H-60 Integrated Maintenance Concept

From Hatcher's master's degree study on the H-60, he concluded, "the results show a weak, but statistically significant correlation between the independent variables, age and squadron type, and the dependent variables, historical SDLM direct costs (18:46)." In his study, he expended what seems like a great effort to compute correlations between variables that in and of themselves, have no meaningful measure. He conceded that more research needs to be done to more fully estimate the costs of depot maintenance including:

total flying hours, shipboard flight hours, recent flight hours (e.g. – 12 months prior to SDLM), number of deployments, aircraft configuration (lot number, Block I upgrade, etc.), ASPA deferrals, number of discrepancies found during ASPA, aircraft modifications in conjunction with rework, in-service repair hours prior to depot maintenance, and O-level maintenance man-hours per flight hour prior to rework (18:46).

He concludes, "wide variations in aircraft age have complicated depot maintenance scheduling [and calls for] depot level maintenance programs to stabilize and become more efficient (18:60)" He also advocates that due to increased costs, an alternative to the depot system must be developed. These seem at odds however. On one hand, he

advocates more of a predictable depot input schedule while having the ability to accomplish depot-level tasks at the fleet. A point to add to his findings might be to show a relationship between the costs of completing PDM tasks at the fleet (just like DART) to those at the depot. It could be that the Navy would find it more effective to use one or the other concept, but not the middle-of-the-road approach that Hatcher advocates. That's where the effort of analysis should be expended.

C-5 Lean Logistics

There were two separate studies done on this logistics problem of trying to bring the C-5 reliability rates up above their pathetic levels – now running around 60 percent. One was the 1999 RAND study, authored by Timothy L. Ramey, called *Lean Logistics: High-Velocity Logistics Infrastructure and the C-5 Galaxy*. One of the main difficulties with this analysis was the large amount of variance in the data. The previously proven model RAND was using had difficulty with the structure of the C-5 system as a whole. The model had been used to determine the logistics needs for the F-16 and had proven accurate. The main difference here was F-16s tended to operate from fixed locations and C-5s operated out of many different sites. The study showed the complexity of the modeling task that included the following attributes.

The model of C-5 operation and support that was developed under this study encompasses 20 bases, 6 intermediate support facilities, 1 depot complex, and 109 aircraft, each composed of 1,908 reparable line items (about 11,000 individual reparable assets on each aircraft). All simulations involved 10 trials of at least 360 days of operation (24:13).

Another problem was inherent from AMC's lack of fully understanding and utilizing the Standard Base Supply System (SBSS) [the standard supply accounting system]. AMC "was reluctant to rely on the data" (24:13) from the SBSS so RAND used "AFMC's wholesale data combined with comparable data gathered by AMC (23:13)." For the remaining variables, the model inputs included mostly historic data. There were difficulties in assessing aircraft status at en-route locations other than AMC-manned bases. Also, "the considerable redundancy in the design of the aircraft and the presence of a maintenance crew chief on board contribute to the resilience of the aircraft, but further cloud the measurement of mission-capable status (24:15)." For AMC missions, it is common for aircraft to operate when only partially mission capable (PMC) as opposed to fully mission capable (FMC). An aircraft that needs maintenance might still be able to meet the requirements and this confounds the modeling.

The first task of the model compared actual performance numbers against the model's simulation and achieved similar results. This became the baseline for other simulation attempts. Then, with the baseline, the model was run with a high-velocity infrastructure (HVI) described previously. The key parts that defined and made this structure HVI were: the next-day delivery of all depot-level repairable in the U.S.; two-day delivery of repairables for all overseas locations; and also, depot repair times are not based on batch time but actual repair time based on one part. (24:17-18) Routinely, the depots wait until they have a certain number of a specific item, hence the batch term, before they repair the whole lot. "Although a major change in the way repair activities are managed at the wholesale level [depot] would be required, experience at the retail level suggests that such a change would be technically feasible (24:18)" Admittedly, the

author says some of these estimates of time are optimistic. He noted that in 1998, service to Qatar averaged 10 days versus the two in the simulation (24:17).

Another item he addresses is cannibalization at CONUS C-5 bases and its affect on mission capable rates. The logistics folks at these locations have this as a tool to enhance mission capability whereas when the C-5 is at an en route location, this is not a factor. Not surprisingly, when he ran the model with no cannibalization at CONUS bases they were similar to the 12 percent reliability at en route locations versus the low 80 percent from the C-5's home base. Eventually, using the model, Ramey found

HVI would enable the C-5 fleet to achieve substantially the same performance *with roughly one-sixth the inventory requirement* of the current infrastructure, and that reduced inventory would cost one-third what it would cost to meet the requirement for the current inventory (24:34).

Once the baseline was completed, the model was run for four different scenarios that included procurement delays, more variability in demand, a small-scale operation, and a large-scale operation. The first considers how an inventory ordered in one year is able to meet the demands of a successive year. Using HVI, this “translates to 1,200 additional en route sorties completed annually by FMC aircraft (24:43).” The second is based on the fact that “one of the most fundamental observations in over 40 years of RAND logistics research has been that demand patterns are uncertain (24:43).” The results of this scenario show HVI only slightly better than the baseline with a small increase, but better than the standard logistics that showed a decrease in capability. For the small-scale contingency, a duplicate effort of the C-5 missions to Somalia was recreated for a Pacific scenario and it also added two additional Travis AFB-based

aircraft. The results were a virtual tie. MC rates remained the same and the departure reliability was only 4.4 percent better for the HVI (24:47). Now, the large-scale scenario did produce vastly different results. The scenario was based on Desert Shield. Again using the Pacific as the backdrop for the scenario, the model increased the number of missions by 1,900 landings. The final tally revealed “that an HVI would produce over 200 more FMC sorties per month than would the standard infrastructure (24:49).” Again though, what is not mentioned is the rates at which the C-5 flies under PMC status due to it having redundant systems.

The study does offer some ideas to fine-tune the C-5 logistics system. However, none of them resolve the logistics problem. These ideas included creating a Europe and a Pacific primary supply point. In essence, this would be like creating a Dover-East and a Travis-West. This would decrease the amount of work for both Dover and Travis and decrease their inventories some. However, the total inventory costs would go up because of the minimum levels of parts each base must carry to meet expected demand. Also, it did not have any appreciable impact on MC rates.

The second study, completed for AMC by the Air Force Logistics Management Agency (AFLMA) in March, 1994, dealt with varying inventory levels under different scenarios to improve logistics support for the C-5 fleet to help make them more reliable. A simulation model, Simulation Language for Alternative Modeling (SLAM), was run for four possible infrastructures to determine the tradeoff between supply stock levels and cost at the C-5 bases. The specific aspects of each infrastructure are not relevant to this paper. However, the one, or maybe two best scenarios as determined by the model should be looked at for further study. “HQ AMC was tasked to conduct an initial test of

the lean logistics concept. The stated goal of the test was to improve support to the C-5 fleet with a reduced logistics infrastructure (25:1).”

The AFLMA analysis used current data from supply records as of September 1993. Also, the team’s assumptions appeared logically consistent. Therefore, the results of their computational effort, while not being 100 percent exact, should at least predict the outcome of maintaining a safety level quantity (SLQ) of supply stock. SLQ is a function of daily demand rate, historic base repair percentage, historic base repair cycle time, and historic order and shipping time required to obtain a replacement item from the source of supply (25:6).

The findings from the computations were put in a table at the end of the report and left the reader to come up with their own conclusion. The team used four infrastructures each with consistent SBSS and three different SLQ levels to arrive at their conclusions. One option had no SLQ, the second set at half the normal level, and the third was at SLQ. Basically, the final numbers predicted what most managers already know – high supply stock levels reduce repair cycle times (this means the C-5 fleet would get repaired quicker and therefore makes the system more reliable) but also, the increased inventory drives up costs quickly. In all four infrastructures, this high-inventory option was nearly double the cost of maintaining the SBSS demand level without SLQ, but the obvious tradeoff was increased cycle times. This greatly decreased the effectiveness of the supply system and therefore, basically made the system unreliable. The middle option of half SLQ appears to strike a balance between acceptable rates and cost. For this however, the leadership must determine how much risk they are willing to accept.

Concerning the four infrastructures, they were in the same ballpark in terms of cost, but one was least costly in all three SBSS/SLQ options. Also, in the words of the authors, it was “probably the simplest of the four structures analyzed (25:19).” Simplicity combined with lowest cost and a way to increase reliability – every leader’s dream come true.

By all accounts then, a derivative of the modeled infrastructure that balances inventory stock levels with aircraft reliability will provide warfighters with reliable systems based upon how much risk they are willing to accept. The infrastructure selected should also be flexible enough to allow for increased or decreased stock levels to meet necessary levels of associated aircraft reliability.

Army Accelerated Logistics

Mark Y.D. Wang authored the RAND study covering the Army’s new logistics concept, Accelerated Logistics. The results overwhelmingly indicate basically that better management of the end-to-end supply chain reduces overall time. This is nothing new, but he did recognize this problem that had existed for decades and arrived at not only a cost-effective solution, but also one that was simple and elegant at the same time.

Through its Velocity Management (VM) initiative, the Army has dramatically streamlined its supply chain, cutting order and ship times for repair parts by nearly two-thirds nationwide and over 75 percent at several of the major Forces Command (FORSCOM) installations (28:xi).

Additionally, the Army leadership seemed to take note that in order to improve and meet the warfighter’s needs, change was required.

VM recognized that achieving dramatic, continuous, and irreversible improvement required a revolutionary shift in thought and action. An organizational structure comprising senior Army leadership, site and process improvement teams, and continuing analytic support from RAND catalyzed the institutionalization of this cultural change, while VM's Define-Measure-Improve methodology sustained it (28:xi).

Changing the corporate mindset to meet the changing needs is difficult as it must overcome the inertia of the organization, especially one as large as the U.S. Army. A couple other points need to be discussed that might reach across the other services and help them as well. The first is scheduled deliveries. Hatcher touched on this when he discussed scheduling a smoother input cycle to the Navy depots. Reliability seems to cost less and this is backed up by “implementation of scheduled truck deliveries from primary depots to customers has been instrumental in improving the Army’s overall supply performance (28:23).” Lessons from this process improvement could be applied to the other services as well. However, given the nature of the other services, full-blown implementation is probably not feasible, but certainly some aspects might help.

V. Findings and Conclusion

No republic will ever be perfect if she has not by law provided for everything, having a remedy for every emergency, and fixed rules for applying it.

Niccolo Machiavelli

Findings

There is a common thread running through these successful logistics programs – revolutionary change to the existing paradigm. By taking an acceptable amount of risk, these programs have yielded positive results – especially the Depot Agile Repair Team (DART) and the Army’s Accelerated Logistics. Application of parts of each program could greatly benefit the sister services. Again, a one-size-fits-all approach is not warranted, nor would it produce the same results, but even incremental increases in cost effectiveness and reliability are advantageous. For each program covered, the main findings are:

- DART is a cost effective program that is also able to meet respectable mission capable rates. However, there appears to be reluctance by Air Force leadership to accept this as a cornerstone for other programs – otherwise we would see efforts in that direction for other weapon systems. Also, difficulties caused by regulatory and political issues are likely constraints to this program being fully implemented on other weapon systems.
- The H-60 process improvement yielded little, but did note that the depot system was costly and suggested another method needed to coexist with the depot to produce sufficient results.
- The C-5 Lean Logistics tests simply brought to light what managers already know – high inventory levels cost money while also increasing the capability of the system. Also, having fixed forward repair points is not cost effective.

Another important note was that leadership must set acceptable levels of risk so the SLQ levels can be adjusted accordingly – this aspect can greatly bring down costs to acceptable levels while maintaining a minimum level of reliability in the fleet.

- The Army Accelerated Logistics test using Velocity Management, like DART, proved highly effective and reliable, but unlike DART, it has gained great acceptance across the senior Army leadership which in turn, will possibly engender an acceptance of future beneficial change.

Briefly, Wang discusses on change in the paradigm of a generation and the effects it can have on future leaders.

Leadership by committee may not always be ideal, but it works well in the military where general officers are reassigned to different positions every two or three years, to gain different experiences during, for example, a European tour of duty or a Pentagon tour. Even though the group has undergone complete changes of officers, focus and momentum can be sustained to drive process changes (28:9).

Review of Research Questions

The purpose of the questions was to guide the direction of this research in accomplishing its goal – knowledge of the logistics system and how it can be improved to meet the needs of the nation’s warfighters. The questions from chapter one are included here as well.

Question 1: How does the current depot system function to meet Primary Depot Maintenance (PDM) tasks and what laws concerning the depot impact possible alternatives?

Addressing the first question provided an in-depth education on the relationships between all the key players – Congress, senior Air Force leadership, private contractors,

and most important, the maintenance crews and logistics folks who must deal with the effects of decisions made at the executive level.

The goal of getting the best bang for the buck seems to be eluding our leaders. On one side, there are those who advocate eliminating the public depot system and replacing it with a private one. The other wants to retain the status quo or maybe, allow some privatization or partnership arrangement to occur.

Col. Mueller, in talking about core capability and depot privatization, surmises that

reducing the cost to the customer, and flow days, through critical path planning and execution, and resource efficiency, reduces variable costs associated with producing the product. Cost per unit output can be on or under the line. Net operating result can IMPROVE. So the margin per product can be greatly improved over the 'cost-overrunning' products that we have had from the conventional process. Faster flow times get expensive weapons back into the hands of the warfighters... so we have more readiness for fewer dollars and days (22:n. pag.).

When all is said and done, the most prudent thing is to give the taxpayers the best value and still meet the warfighter's needs. A difficult situation must arise, very much like BRAC, where the present paradigm must be put aside and effective, risk acceptable change allowed.

Question 2: Was the Air Force Special Operations Command (AFSOC) Depot Agile Repair Team (DART) concept (run on its relatively small (numerically) MH-53 helicopter fleet) truly effective?

This question focused on the AFSOC's DART concept. This was necessary in that there needed to be a demonstrated success story to show that alternative sources of

repair can be cost effective and produce a quality product. After reviewing the data, both recent and near recent, it only seems to be getting better with time.

An idea that sprouted from this led to the iterative thought that if DART is able to do more work every year for the same amount of money, then they'll obviously take more work from the organic depot. To make up for the lost work and their ability to pay back into the Working Capital Fund, the depot would have to charge higher rates. This would offset the lost workload and maintain the organic depot's overhead costs. Therefore, if their dollar amount increased, then the Air Force could increase the DART the same amount. In essence, because of their ability to increase their productivity, combined with the increased dollar amount to maintain the 50-50 rule, the DART would eventually put the depot out of business. This has been referred to as the depot death spiral by some of the discussions with logistics personnel for this paper.

Question 3: Can an alternative logistics method, such as DART, be applied to a numerically significant fleet, say the C-5s, and prove effective?

Lastly, the final question wondered if we could take a concept like the Army Accelerated Logistics, the DART concept, the H-60 compromise plan, or the Air Force Lean Logistics and apply some aspect of it to the C-5 program and make it work. Having one solution to this is difficult to prescribe. The reliable scheduling ideas behind the Army's plan and the H-60 are sound. After thorough analysis of the C-5 SLQ and what is truly necessary, then a scheduled flow to the forward locations, where most of the reliability problems occur, of the replacement parts might help. Also, possibly a rotation of a small team, based on the DART concept, of both contractors and organic maintenance to a forward location to work on aircraft might also help. Additionally, as

with the DART concept, the younger, inexperienced maintenance troops are learning a great deal from working alongside the contractor team. Because most of the contractor team is retired military (this is true of DART), they have vast experience and can pass some on to the maintenance troops. This is an immeasurable factor that can only benefit the Air Force as a whole.

Warden's "New American Security Force"

Further, an additional idea that should also be considered is the necessity and political reality of having a large, standing military and infrastructure. This shows the need for additional changes that could be applied to improve our logistics capability. It would force the nation to completely overhaul the current system and might end up relying on the concepts studied in this paper.

The political realities of today's world may not translate to a large-scale war along the lines of World War II or even the smaller Gulf War. The advent of precision guidance munitions, global reach, and our nation's technological advantage gives us that effective deterrent to rogue nations that thousands of nuclear weapons did during the age of Mutually Assured Destruction. Col. John A. Warden, USAF (ret), famous for his Centers of Gravity concept for prosecuting the Gulf War, has written on the very subject.

He advocates that

We must develop and field new systems rapidly -- but in numbers just sufficient to force potential enemies to devote impossible efforts to defense or simply abandon military provocation. In other words, we become the threat. Instead of following our old practice of developing a new offense or defense in response to someone else's developments -- a concept institutionalized in the acquisition milestone process -- we become the threat and force everyone else to react to us. (29:5)

On acquisition, he feels that “long acquisition cycles guarantee technological and concept obsolescence in a fast-time world (29:5).” The need for flexibility in our logistics system should be comparable to our productive use of new computer technologies. There are certainly few, if any -286 powered computers being used by Air Force personnel and the market for them lasted until just about 8 years ago. Lowering our purchase amount also lowers the costs associated with the hidden part of the iceberg from figure 6 – and that’s where 60-75 percent of the life cycle costs occur.

Conclusion

Logistics change is inevitable. The question then becomes, “How do we get there?” A revolution in new technologies in planning and manufacturing support quick response to calls for new systems as advocated by Col. Warden. They also contribute to the success of programs like DART and Accelerated Logistics. Using new computing power with valid models can further assist the Air Force in designing a plan, with an acceptable amount of risk as determined by the senior leaders, that will meet and possibly exceed the needs of the country’s warfighters.

Appendix A: Glossary of Terms

Awaiting Maintenance (AWM): Designation for a deferred discrepancy on an aircraft awaiting maintenance. (8:68)

Awaiting Parts (AWP): Designation for a deferred discrepancy on an aircraft awaiting parts. (8:68)

Bench Stocks: Stores of expendability, recoverability, reparability coded (ERRC) XB3 items kept on-hand in a workcenter to enhance maintenance productivity. (8:68)

Cannibalization: Authorized removals of a specific assembly, subassembly, or part from one weapons system, system, support system, or equipment end-item for installation on another end-item to meet priority mission requirements with an obligation to replace the removed item. (8:68)

Depot Level Maintenance: Maintenance consisting of those on- and off-equipment tasks performed using the highly specialized skills, sophisticated shop equipment, or special facilities of a supporting command; commercial activity; or inter service agency at a technology repair center, centralized repair facility, or, in some cases, at an operating location. Maintenance performed at a depot may also include organizational or intermediate level maintenance as negotiated between operating and supporting commands. (8:69)

DynaMETRIC: An analytical tool for gaining an understanding of the implications of logistics-system alternatives for military capability. (23, xi)

Intermediate-Level Maintenance: Maintenance consisting of those off-equipment tasks normally performed using the resources of the operating command at an operating location or at a centralized intermediate repair facility. (8:69)

Mission Design Series (MDS): Alpha and numeric characters denoting primary mission and model of a military weapons system. (8:69-70)

Off-Equipment Maintenance: Maintenance tasks that are not or cannot be effectively accomplished on or at the weapon system or end-item of equipment, but require the removal of the component to a shop or facility for repair. (8:70)

On-Equipment Maintenance: Maintenance tasks that are or can be effectively performed on or at the weapon system or end-item of equipment. (8:70)

Organizational Level Maintenance: Maintenance consisting of those on-equipment tasks normally performed using the resources of an operating command at an operating location. (8:70)

Programmed Depot Maintenance (PDM): Inspection requiring skills, equipment, or facilities not normally possessed by operating locations. (8:70)

Quick Reference List (QRL): Listing of those fast-moving, high-use items required for primary mission aircraft. The basic purpose of the QRL is to provide maintenance personnel with a speedy way to place a demand on the supply system. (8:70-71)

Utilization Rate (UTE Rate): Average number of sorties or hours flown per aircraft per period. (8:71)

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Vita

Major Paul A. LaVigne was born in Hawthorne, Nevada. He graduated from Glenelg High School in Glenelg, Maryland in June 1983. He then attended Syracuse University in Syracuse, New York, including spending his junior year as an exchange student at City University, London, England. He graduated in 1987 with a Bachelor of Science in Electrical Engineering. He was commissioned through ROTC Detachment 535, Syracuse University, in December 1987. He also received a Master of Arts degree in Business from Webster University in 1997.

His first assignment was Specialized Undergraduate Training at Mather AFB, California in 1988. Upon receiving his navigator rating in 1989, he was then assigned to McGuire AFB, New Jersey as a C-141B navigator and eventually progressed to instructor navigator. From there, he transferred to Altus AFB, Oklahoma, in 1994 to be a formal schoolhouse instructor and evaluator. In 1997, he moved to Charleston AFB, South Carolina and became a Special Operations Low Level II (SOLL II) evaluator navigator, flight commander, and Operations Group Standardization and Evaluation Navigator.

In 2000, he entered the Advanced Study of Air Mobility program at the Air Mobility Warfare Center at Fort Dix, New Jersey. This is an Air Mobility Command-sponsored master's degree administered by the Air Force Institute of Technology.

He has accumulated just over 3,000 flying hours and has flown in operations including DESERT SHIELD/STORM and also worked on the DIRMBOFOR staff for Operation ALLIED FORCE.

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14. ABSTRACT <p>Currently, some Air Force logistics leaders have stated that even though the Air Logistics Centers (ALC) have been consolidated, they are still not as effective, as measured by time savings, cost savings, or system reliability as they can be. JV2020 even alludes to this need for change as a requirement for the future of our forces.</p> <p>Therefore, this research proposes to identify and evaluate possible substitutes to some of the current logistics programs that affect aircraft availability including alternatives to depot maintenance and also, how to better move repair parts through the system to meet the warfighting vision of N2020. This will be accomplished by looking at AFSOC's Depot Agile Repair Team (DART) program on the MH-53 helicopter, the Navy's H-60 helicopter, C-5 Lean Logistics concept, and the Army's Accelerated Logistics concept.</p> <p>The study found a common thread among all these programs -a paradigm-breaking change in how to meet warfighters' needs and maintain cost effectiveness. The two helicopter programs both point to the need for keeping aircraft more operationally available and this is done by performing some depot-level tasks at the unit level. The DART concept has proven highly effective in increasing aircraft availability while also reducing costs. Also, by looking at the Lean Logistics and Accelerated Logistics concepts, these demonstrated another way to increase aircraft availability by moving replacement parts through the system more effectively</p>					
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